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Learning experiences of engineering students related to cultural differences in group work

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1 INTRODUCTION

During the last few decades the number of international engineering students at master level increased radically in many western countries. In particular, in a Project Based Learning (PBL) curriculum these students are exposed to cross cultural context. In the projects, collaboration and communication among students are a major factor influencing their learning experiences. In the context of engineering education this experience is an important contribution in the preparation of professional practices. Reports on the future of engineering by the National Academy of Engineering mention the need for engineers to work across cultures and across disciplines [1]. The meanings, they need to understand the concept of global collaboration and communication in engineering.

The objective of this paper is to explore the influence of cultural differences on collaboration and communication by investigating the experiences of engineering students during their learning process in intercultural student groups. We will explore why it is important to look at the cultural issues in engineering and how it is influencing the engineering practices. As a consequence, how engineering universities are nurturing their students to understand cultural issues, cross-cultural communication and collaboration skills to work in the global context of engineering. The faculty of Engineering and Science at Aalborg University Denmark is selected as a site for this research due to the presence of an intercultural environment in PBL context. (See table 2)

2 GLOBALISATION AND ENGINEERING EDUCATION

There is broad recognition that engineering education needs to change in order to meet the challenges of the knowledge society [2]. We are living in a changing society where events and innovations in engineering along with expectations of stakeholders involved have resulted in

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the globalisation of engineering. Wulf reported several trends, which he feels characterise the globalisation of engineering. Among them we notice: a vast array of new materials and processes, use of information technology, a need to have both specific technical knowledge and breadth of knowledge, a need for teamwork, and a rapid pace of change calling for lifelong learning [3].

Few reports in recent years have highlighted the globalisation factor in engineering and how engineers need to respond these changes. For example, '*The 21st-Century Engineer, A Proposal for Engineering Reform'* cited in Parkinson, addresses in detail the globalisation issue in engineering. It states: *'A solid understanding of globalization is key to an engineer's success in today's global society. Globalization involves the ability to understand that the world economy has become tightly linked with much of the change triggered by technology; to understand other cultures, especially the societal elements of these cultures; to work effectively in multinational teams; to communicate effectively—both orally and in writing—in the international business language of English; to recognize and understand issues of sustainability; to understand the importance of transparency while working with local populations; and to understand public policy issues around the world and in the country in which one is working. It will be these fundamental capacities that will enable 21st-century engineers to develop into professionals capable of working successfully both domestically and globally, highly respected by the general public and regarded… the world over as professionals of the highest order'[4].*

Innovations in information and communication technology support the process of globalisation. During the last few decades, a variety of inventions have made information and communication instantaneous, such as radio, television, telephone and computers. The internet has brought a revolution in the lives of human, which resulted in new ways of collaboration and communication among individuals and nations.

Information technology is not the only single factor behind the globalisation, many political events have changed the landscape, which foster the globalisation, examples include the formation of the European Union (EU). The EU allows and promotes the freedom of movement of people, ideas, capital and goods, which are the basic ingredients of globalisation. Similarly economic blocks are emerging around the world, like the North American Free Trade Agreement (NAFTA). It is not only the governments also transnational organisation influencing the globalisation; among those are the World Trade Organisation (WTO), the International Monetary fund (IMF), the World Bank.

Above mentioned technological innovations, political changes and economic interdependencies have turned out as a basic step in the formation of multi-national companies. Like Apple, Hewlett Packard, General Motors, Intel. But what are the implications of these developments for the society and the role of the engineers in it? According to Hofstede, the survival of humanity will depend to a large extent on the ability of people who think differently to act together [5]. Globalisation is creating a context in which engineers from one culture need to collaborate and communicate efficiently with professional from other cultures. In this changing context of the engineering profession, the successful engineer will not be the one with only sound knowledge of science and technology, but also can understands cultural issues and has the ability to communicate and collaborate across the cultures. It is important to see what it mean cultural issues and how one culture is different from others?

3 CULTURAL DIFFERENCES

It has long been argued that cognitive processes, just like the beliefs and values held by an Individual depends on the social, political and economic environment in which he socialized [6]. This perspective is of utmost importance, especially taking into consideration the

increasing number of intercultural activities in teaching and learning in recent years. According to Hofstede behaviour, attitude, values, norms of individual are rooted deeply in the culture from which they originate [5]. Culture is a complex concept and has many dimensions. In order to understand cultural difference in detail, many studies were conducted, one of the most prominent is by Geert Hofstede, based on his analysis he presented different indexes of cultures, which differentiate one culture from the other. His indexes have five dimensions [5]. Nisbett shows that culture influences the patterns of interactions and modes of communication [6]. From the socio-constructivist perspective of learning, it is very important. Consequently, cultural differences have implications for educational institutions, where the learning principles are based on social constructivists' principals.

3.1 The Implications of Cultural Differences in Teaching and Learning

Hofstede argues that interactions and communication between student-teacher and student-student are deeply rooted in their belonging cultures. Such a cross-cultural situation could be problematic for each of them. Hofstede has categorised the reasons of these problems into four categories which are: 1) differences in social positions of students and teachers in the society, 2) differences in the relevance of curriculum in different cultures,3) Differences in cognitive abilities,4) differences in the cognitive abilities of students. Hofstede further relates the interactions and communication with his original cultural dimensions [7].

Power Distances in lower power distance cultures, the education is majorly student –centred in which a student can oppose or criticise the teachers' arguments. Teachers expect that student will take initiatives and start the discussion, while it is opposite at the educational institutions within the higher power distance societies. The mobility of students from one culture to others could have complications for some students to learn in the new learning environment.

Individualism vs. Collectivism In the individualistic society students are expected to learn how to learn, while in a collectivist culture, students are expected to learn how to do.

Masculinity vs. Femininity Masculine societies support the academic performance and student compete with each other in class, while the feminine society supports the students' adaptation. Students show mutual cohesion in class.

Uncertainty Avoidance In strong Uncertainty Avoidance cultures, the students enjoy their learning process in a structured situation; there are detailed rules and regulations from the administration and teachers. The students are given grades based on the accuracy in problem solving and written reports. Disagreement with the teacher is taken as personal disloyalty, while in weak uncertainty avoidance cultures; students feel enjoyment in unstructured learning settings, broad rules and regulations. Rewards are given for innovative ideas; similarly disagreement with a teacher is taken as intellectually stimulating exercise [7].

4 PROJECT BASED LEARNING

The changing context in Engineering has put pressure on the universities to prepare engineers for the drastically different workplace of the future. How can universities tackle this challenge? There could be many ways - though yet needs to explore, but the two proposed options are: either to put the content related to working in an intercultural setting in the curriculum or to provide engineering students a learning environment where they have a probability to collaborate and communicate with students of diverse cultural backgrounds. This paper argues that Project-Based Learning provides just such an environment.

PBL is an educational approach to organize the learning process in a way that the students are actively engaged in finding answers by themselves [8]. In a PBL context students mainly work in collaborative groups, identifying independently what they need to learn in order to

solve a specific professional problem. The teacher acts as a facilitator of the learning process, while the students take responsibility for directing their own learning. Aalborg University in Denmark is one of the universities founded on PBL principles [9]. The success of PBL is illustrated by the fact that since last couple of decades, this method has been introduced in many universities all over the parts of the world. PBL is practiced in different ways in different parts of the world with different names. Graaff and Kolmos formulated three common approaches which characterize PBL: 1) the learning approach is organized around problem, context and the experience of the students, 2) the content approach is characterised for interdisciplinary learning, 3) the social approach suggest that most of the learning takes place in a group. According to this approach learning is social act where student not only learn from each other but also they also develop collaborative learning skills [10].

According to Hmelo-Silver the goals of PBL include helping students develop, 1) flexible knowledge, 2) effective problem-solving skills, 3) self-directed learning skills, 4) effective collaboration skills, 5) intrinsic motivation [11]. There are many research studies conducted to check the effectiveness of PBL, by comparing with other teaching methodologies. Recently,

Dochy (2003) reviewed forty three studies conducted in the 90s on PBL and his main conclusion is that the use of PBL has an impact on improvement of skills development such as process competencies or skills. The impact of knowledge acquisition is missing or not significant [12]. According to Du the students in PBL do not acquire less knowledge compared to traditional educated students [13].

The enrolment at universities in the western world automatically creates an international study environment at the campuses. Humfry (1999) explain the benefits of the international study programme as: *At its highest level, the benefits of such education could be global understanding and harmony – more realistically, they (university) should at least include the facilitation of friendships across international boundaries, more effective development of global knowledge base* [14]. The PBL curriculum enhances these effects through enforcing communication among students, as PBL utilizes collaborative learning.

4.1 Collaborative Learning

Collaborative learning is a student centred teaching and learning system in which a group of students acts as a team to learn. In the process of collaboration the students share, discuss and exchange ideas, knowledge and information. In this way, it is mainly the students themselves, who take responsibility for their own learning. Previous studies on collaborative learning established several benefits [18] Furthermore, collaborative learning activities act as a site for intercultural understanding; it may facilitate the active participation of students who have a lot of difficulties in traditional school learning [15].

From the perspective of social-constructivist, the essential components of the learning are social interactions and collaboration among the group members, where the peers interact with each other in a learning community [16]. However, major challenge in intercultural student group is that every member ‘s behaviour on interaction and collaboration is based on the cultural background [7].So collaboration and communication are particularly important for a student in collaborative learning experience, cultural differences could pose a challenge and impact in the collaborative learning process.

4.2 Communication in Collaborative Groups

Intercultural communication is the ability of an individual to communicate and interact with an individual from another culture [17]. In inter cultural student groups success of intercultural communication can be seen can be seen in term of maintenance of relation and willingness to work further in the intercultural groups. Byram proposed a model to understand the factors involved in intercultural communication [17].

	Skills(interpret and relate)	
Knowledge(self and others)	Education(critical cultural awareness)	**Attitudes**(about self and valuing others)
	Skills(discover and/or interact)	

Table 1: Model of intercultural communication adapted from Michael Byram(1997)

4 RESEARCH METHODOLGY

Since the focus of this research paper was to explore and understand the approaches of communication and collaboration in the intercultural student groups, qualitative methodology was used to investigate this phenomenon. Qualitative research can be used to understand any phenomena about which little is known or it is difficult draw conclusions based on quantitative data [22]. In qualitative research it is very important to study the issue or problem at the research site where the participants are experiencing it. In this project the research site is Aalborg University because Project Based Learning principles are being practised in all study programs since its formation in 1974 [9]. It provides a suitable site for conducting this research due to presence of international students. As the study focuses on the viewpoints and experiences of students about collaboration and communication in intercultural PBL groups, it was important to observe the students in intercultural student groups at their learning site, instead of only conducting in-depth interviews.

Nine intercultural student groups were selected through a pre-designed procedure from the faculty of Engineering and Sciences. Each student group was observed three times (each time three hours) during their group work, mainly in their group rooms. All observations were videotaped (with the consent). The description of observations is based on the observational protocol used during the observation process. It includes some questions to be asked, bearing on the objective of the research

Group No	Nationality	M	F	Total	Group No	Nationality	M	F	Total
1	China	0	1	5	5	Romania	0	1	5
	Poland	0	2			Denmark	0	2	
	Germany	0	1			Germany	0	1	
	Bangladesh	0	1			Bulgaria	0	1	
2	Romania	0	1	5	6	Denmark	0	2	5
	Indonesia	0	1			Kenya	1	0	
	Germany	0	2			Czech	0	1	
	Denmark	1	0			Germany	0	1	
3	Denmark	2	0	5	7	Romania	2	0	5
	France	1	0			China	2	0	
	Romania	1	1			Nepal	1	0	
4	Denmark	3	2	7	8	India	1	0	3
	Spain	0	1			France	1	0	
	Italy	0	1			Romania	0	1	
5	Denmark	3	0	6					
	Australia	1	1						
	Germany	1	0						

Table 2: Composition of the student groups under observation

5 FINDINGS

Note: This paper is a part of a PhD project; the initial findings and reported and discussed. It is expected that in detail analysis will be presented at the time of conference.
Data was collected from the observation of 46 students belonging to 16 countries. Twenty in depth interviews were conducted and almost every student reported some of 'good' or 'bad' experiences due to the cultural differences in communication and collaboration. Sense making of the students regarding good and bad experience were cluster around the themes of self-adequacy and others inadequacies.

In an effort to understand the influence of cultural differences in intercultural student group in the context of PBL learning environment in engineering education, this study explored those issues and challenges that students face in collaborative work. Based on continuous observations and collecting viewpoints of the students by conducting interviews. The initial analysis suggests there are a few factors that influence the communication and collaboration in the intercultural student groups significantly:
a) Language was a big factor in the collaboration. Each student was coming with different level of spoken language. It was not only the level of English language; rather communicating within the group was rooted in their culture. The level of contribution in group discussion was a big problem for some student. They tend to remain quite most of the time, which is frustrating for others. Efforts to involve all students in the discussion take a lot of group work time.
b) Time management often gets disturbed in an intercultural group. Some students due to their previous experience don't want to spend all the time in the group room. Deadlines are often violated, that create a rift among group member.
c) Preconceptions of autochthonous students about the lack of interest by international student in group work and the way international students "exploit" the local students in group work contribute to a negative image about collaborative group work.
d) Agreement on group rules is important in the intercultural group, the rules are broken many times, which create disbelieve among group members, which creates negative behaviours for collaboration and communication in intercultural groups.

The following extract from few students are good to understand what happen in intercultural student groups, which actually leads to experience of collaboration and communication *"I know it is good experience to work with international students…. I am sorry to say but after the experience of one semester with international student I will prefer to work with Danish student groups in the future. It is Okay to work with student from Nordic part, rest of the international students from Eastern Europe and Asia have a big problem in expressing their ideas….. the big problem is communication they don't speak, sometime they are too silent! and it is important for group work… they are new to group work also… I feel group work here is very intensive and I don't want to act as a mother in the international student group all the time"* (Danish student). Looking at that expression, it did not points out directly the issue of language as a specific problem. It seems the group members have different abilities in expressing the ideas in English. It was very clear from the observations that many times in many groups during intensive discussion, some members belonging to same culture started to speak in their native language. The further culturally rooted behaviour of communication and collaboration add complication into it.

It also shows that the local Danish students have to work in a different way in intercultural groups than their previous experiences of group work with their own country students. International students show dependency on the local students. In that way the ideal spirit of collaborative learning disappears, It can also be seen from the experience of an international student "*It is very good, we have one Danish and then some other European and one from China. It is very good, I learn about their culture. We ask a lot to Danish girl. She is so kind*

we ask a lot to her and she tells us same things many time and she never say no to us…. But if we have one more Danish in our group then it would be great, but its pity Danish students don't want to make group with us!" (A student from France). It indicates that the centre of all communication is local students. From the perspective of intercultural learning, there is a need to manage the communication flow in intercultural groups. It is important how they are utilising the expertise of each group member. The international students who are new to the group work should utilise the experienced group members to learn the complexity of group work, from the observation it was clear that the new group member were asking a lot of questions about out of campus life and practical issues at campus like accommodation, library . This example adding clarity to the above picture.

Yes, of course in start it was very, very big problem for me to work in the groups. In my group there was one Danish student. I would say he was so nice, we and specially I was always asking him very stupid or silly question and always responded them with patience. He was only who know about group work, so he actually guides us in a way even more than a teacher, how to work in groups. He was so good in the project management. ..Even we have lots of problems. We all members of the group have different background and understanding about any issues. So we have almost every time quarrels. There was no day when we have a discussion and we have no problem, everybody was strict on his point without listening others, but slowly we manage it. The other problem was it was too time consuming without any productive outcomes (international student from Asia).

7 DISCUSSION AND CONCLUSIONS

To meet the challenges of global engineering, the engineers for the future need to work across national borders with the ability to collaborate and communicate with engineers from different cultures. It is a new important competence for engineers. It is now the responsibility of present day universities to prepare the engineers for this challenge. Culture has a significant influence on the collaborative activities during the group work in an intercultural environment. It is challenging (in terms of collaboration due to different communication skills, behavioural pattern, learning styles) to work in intercultural student groups but it is also rewarding (in terms of intercultural learning, employability). These challenges and rewards must be taken into consideration when designing activities for international students and forming th intercultural students groups. It is important to note that culture is not the sole factor influencing the collaborative activities, there might be other factors like age, gender, socioeconomic background etc. It was observed that the nature of challenges to student groups are similar to extent like coordination of tasks, negotiations, deadlines, time and conflict management, decision making, agreement on group rules in both home student groups and intercultural groups but intercultural differences were adding extra layer of complexity to these issues. There is need to understand this layer of complexity. Even though there are challenges in intercultural student groups, yet it must be acknowledged that PBL at Aalborg University provide a space for intercultural learning by facilitating the group work.

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